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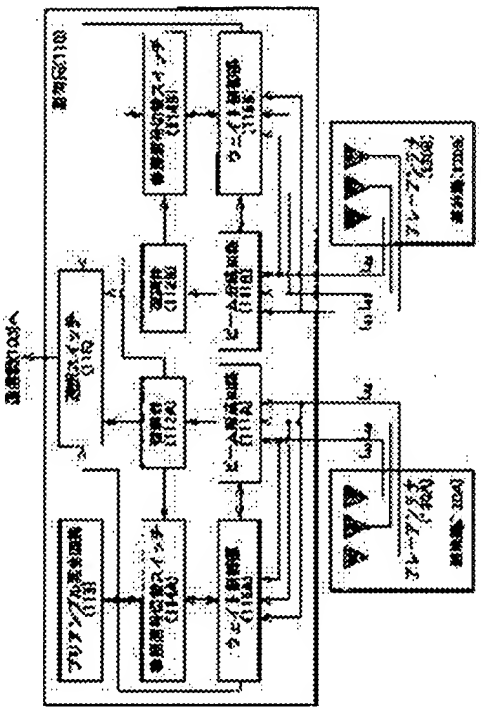
(54) MOBILE COMMUNICATION SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a mobile communication system that can conduct initial acquisition in a short time while keeping the communication efficiency high at selection of a base station.

SOLUTION: The mobile communication system includes a mobile station, base stations each having an array antenna and a control station that controls the base stations. The control station is provided with beam forming means that applies weight synthesis to signals from a mobile body received by each base station, a plurality of demodulation means that is connected to each of the beam forming means and applies demodulation processing to the signal from the mobile station received by the beam forming means, and a plurality of weight communication that calculates a weight to be set to each beam forming means corresponding to each of the beam forming means. An output of the demodulation means corresponding to one base station is connected to an input of a weight control means corresponding to base stations adjacent to the one base station. The weight control means corresponding to the adjacent base stations use an output signal from the demodulation means corresponding to the one base station for



a reference signal to calculate the weight.

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* NOTICES *



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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the mobile communication system which can shorten base station switching time especially about the mobile communication system containing the control station which has jurisdiction [ base stations / a mobile station, two or more base stations, and / two or more ].
[0002]
[Description of the Prior Art] A transit support system (AHS:Advanced cruise-asist Highway Systems) is technical most advanced system in current and the altitude route communication system (ITS:Intelligent Transport Systems) currently examined. The final gestalt of AHS is a cruise-assist highway system, and aims at relief of the burden of a driver.
[0003] In a cruise-assist highway system, a mobile station always needs to notify the local station information about the passing speed, obstruction, etc. to a control station. The communication link between a mobile station and a control station is not allowed to be cut on insurance.
[0004] The signal transmitted from the mobile station is received by the control station through a base station. Using an adaptive array antenna is examined as an antenna of this base station. An adaptive array antenna can change the directivity accommodative according to the location of a mobile station, and, in addition to improvement in CNR by directional gain, is an effective technique also as a cure against phasing.
[0005] Many algorithms which control the wait of an adaptive array antenna are proposed conventionally. For example, the output power minimization algorithm with direction constraint (DCMP:Directionally Constrained Minimization of Power) oppresses an interference wave, maintaining the gain of the desired direction of a mobile station by direction constraint. The positional information of a mobile station required for direction constraint is determined based on the information transmitted from a mobile station. Or acquiring the positional information of a mobile station is also considered using direction presumption algorithms, such as a MUSIC algorithm. However, a DCMP algorithm has the fault of being inapplicable, in a multi-pass environment.
[0006] On the other hand, a constant envelopment algorithm (CMA:Constant Modulus Algorithm) is applicable to a multi-pass environment. However, since, as for this approach, the modulating signal uses having a constant envelopment property, the propriety of application has the fault of being dependent on the method of a modulation.
[0007] On the other hand, the algorithm based on the least square error method (MMSE:Minimum Mean Square Error) represented by LMS (Least Mean Square) can control a wait to make the mean squared error of the input signal of an adaptive array antenna, and a reference sign into min, and can apply it also to a multi-pass environment.
[0008] As a reference sign, the same signal as the preamble of the slot which a mobile station transmits is used in the phase of the initial prehension before desired directivity is formed. The signal which the mobile station transmitted when desired directivity was formed is the base station of the area as for

which the mobile station is carrying out current migration, and is once received rightly. So, in the phase of such directive flattery, the thing itself which restored to the signal which the mobile station transmitted is used as a reference sign in the area.

[0009]

[Problem(s) to be Solved by the Invention] By the way, in case a mobile station moves to another area which adjoins from a certain area, base station change-over processing which changes a mobile station and the base station in a current communication link condition to the base station of the area of an adjoining migration place is performed.

[0010] The adaptive array antenna of the base station of a change-over place is in the phase of initial prehension where desired directivity is not formed yet, at the time of a base station change-over. In this phase, wait control based on MMSE (minimum mean squared error) is performed among communication link frames only using the section of a preamble. However, the rate that a preamble occupies with a transmitting frame needs to perform wait control in the preamble section ranging over several frames, by the time the directivity of a request in the next area is formed, since it is very small compared with an information bit. The base station (namely, front area) of a switching agency must be maintaining the communication link condition with a mobile station so that a communication link may not be cut in the meantime. For this reason, the large field overlapped and covered between base stations had to be taken, installation spacing of a base station became narrow as a result, and lifting of cost was caused.

[0011] Although lengthening a preamble with a communication link frame is also considered in order to avoid this, decline in communication link effectiveness will be caused shortly.

[0012] Then, even if a preamble is short, initial prehension is completed for a short time, and this invention aims at realizing the mobile station which can perform a base station change-over smoothly, a base station, a control station, and mobile communication system.

[0013]

[Means for Solving the Problem] In order to solve this technical problem, the mobile communication system of this invention contains a mobile station, two or more base stations which communicate with this mobile station, and the control station which has jurisdiction [ base stations / two or more ]. As for two or more base stations, each base station has an array antenna including the 1st and 2nd base stations at least. A control station has two or more beam means forming corresponding to each of two or more base stations. Each beam means forming carries out weighting composition of the input signal received in the corresponding base station based on the set-up wait. Each beam means forming is connected to the recovery means corresponding to each base station, and each recovery means carries out recovery processing of the output of beam means forming. A control station is equipped with two or more wait control means corresponding to each base station again, and computes the wait set as each of two or more beam means forming. As a description of this invention, the output of the 1st recovery means corresponding to the 1st base station is connected to the input of the 2nd wait control means corresponding to the 2nd base station, and the 2nd wait control means computes a wait, using the output signal of the 1st recovery means as a reference sign.

[0014] When a mobile station moves to the area of the 2nd base station from the area of the 1st base station by such configuration, the wait given to the beam means forming of the 2nd base station of a migration place is computed by using the whole recovery signal acquired corresponding to the 1st base station as a reference sign. That is, in addition to the preamble section of a communication link frame, the section of an information bit can also be used for wait control at the time of a base station change. Consequently, it becomes possible to carry out the probability of the directivity of the array antenna of the base station of a migration place for a short time, without straddling several frames. By the ability forming the directivity of an antenna in a short time, the field overlapped and covered between base stations can be narrowed, and the installation cost of a base station can be reduced. Moreover, it becomes unnecessary to take a long preamble with each communication link frame, and communication link effectiveness improves.

[0015] The 2nd wait control means corresponding to the 2nd base station of a migration place computes

the mean squared error of a reference sign (namely, output of the recovery means corresponding to the 1st base station of a moved material), and the output signal of the beam means forming corresponding to the 2nd base station, and sets the wait which makes this min as the beam means forming corresponding to the 2nd base station. By this, the section of an information bit can also be used, wait control based on MMSE (minimum mean squared error) can be performed in addition to a preamble, and it can apply to a multi-pass environment.

[0016] Moreover, initial prehension can be completed in a short time by setting up the initial value of the wait set as the beam means forming corresponding to the 2nd base station of a migration place so that the directivity of the array antenna of this 2nd base station may turn to the field which the 1st base station and the 2nd base station overlap and cover.

[0017] Preferably, a control station has further the selection means for switching which changes selectively the signal from the mobile station received in each base station, and is supplied to a communication network. When the mean square error computed by the 2nd wait control means becomes below a predetermined value, a selection means for switching changes the signal to which it was received in said 1st base station, and restored with the 1st recovery means to the signal to which it was received in said 2nd base station, and restored with the 2nd recovery means, and supplies it to said communication network. That is, desired directivity is formed in the array antenna of the 2nd base station, after the signal which the mobile station transmitted is in the condition of mistaking through the 2nd base station of a migration place, and getting over there being nothing, a change-over of a base station is performed and communicative safety and dependability are secured.

[0018] A selection means for switching is good also as a configuration changed to the signal which restored to the signal to which it restored with the 1st recovery means corresponding to the 1st base station with the 2nd recovery means corresponding to the 2nd base station, when the mean square error computed by the 2nd wait control means corresponding to the 2nd base station of a migration place becomes smaller than the mean square error computed by the 1st wait control means corresponding to the 1st base station of a moved material. When the receive state in a migration place base station becomes better than the receive state in the base station of a moved material by this, a base station change-over can be performed and dependability improves.

[0019] The mean square error computed as another example of a configuration of a selection means for switching by the 2nd wait control means corresponding to the 2nd base station of a migration place is continuously compared with the mean square error computed by the 1st wait control means corresponding to the 1st base station of a moved material, and you may make it give the output signal of the recovery means corresponding to the mean square error of the smaller one to a communication network. In this case, after the effectiveness of the site diversity of choosing the signal of the always better one is acquired, for example, a mobile station goes into the area of the 2nd base station of a migration place and the directivity of an antenna is formed, it also becomes the cures against shadowing when a communication link is blocked by a truck and the obstruction.

[0020] A mobile station can perform wait control based on MMSE, and can make directivity follow accuracy more by always transmitting a signal in the given communication channel according to the location of a mobile station.

[0021] The signal which a mobile station transmits is the local station information about passing speed, an obstruction, etc. of a mobile station. Thereby, directivity can be made to follow accuracy more according to the location of a mobile station. Simultaneously, the safety of a cruise-assist highway system can be improved.

[0022]

[Embodiment of the Invention] Hereafter, the suitable operation gestalt of the mobile communication system concerning this invention is explained to a detail using an accompanying drawing.

[0023] (The 1st operation gestalt) Drawing 1 is the schematic diagram of the mobile communication system concerning the 1st operation gestalt of this invention. This mobile communication system contains the control station 110 which has jurisdiction [ base station / a mobile station 150, two or more base stations 120A, 120B, and 120C which communicate with this mobile station 150, and / of these

plurality ]. A control station outputs the signal from the mobile station received through the base station to a communication network 100. Each base station covers Area 140A, 140B, and 140C, respectively, and each area overlaps mutually. When a mobile station is in duplication area, it is received in the base station of the both sides of migration place and migration origin, and the signal which a mobile station emits forms the directivity of the antenna (refer to drawing 2 ) of the base station of a migration place in the meantime.

[0024] Drawing 2 is the block diagram of the base stations 120A and 120B of the mobile communication system shown in drawing 1 , and a control station 110. A mobile 150 shall move toward jurisdiction area 140of base station 120B (it considers as "2nd base station" hereafter) B, and has omitted [ from jurisdiction area 140of base station 120A (it considers as "1st base station" hereafter) A ] drawing about the part corresponding to base station 120C with this operation gestalt among control stations 110 for simplification of explanation.

[0025] Each base stations 120A and 120B have array antennas 130A and 130B, and receive the signal transmitted from the mobile station 150. Drawing 2 shows only three signal lines L1, L2, and L3 prolonged from three antenna elements of each array antenna for simplification. A control station 110 has the 1st and 2nd beam formation circuitA [ 111 ] and 111B, 1st and 2nd demodulatorA [ 112 ] and 112B, 1st and 2nd reference-sign change-over-switchA [ 114 ] and 114B, 1st, and 2nd wait control sections 115A and 115B respectively corresponding to the 1st and 2nd base stations 120A and 120B.

[0026] The beam formation circuits 111A and 111B carry out weighting composition of the signal received by the corresponding array antennas 130A and 130B of base stations 120A and 120B based on the set-up wait. Demodulators 112A and 112B carry out recovery processing of the signal from a mobile station 150 based on the output of the beam formation circuits 111A and 111B.

[0027] A control station 110 is equipped with the preamble generating circuit 113 again. The preamble generating circuit 113 generates the same signal as the preamble contained in the sending signal of a mobile station 150.

[0028] Reference-sign change-over-switch 114A corresponding to 1st base station 120A chooses the recovery signal to which it restored by 1st demodulator 112A, or the signal generated by the preamble generating circuit 113, and outputs it to 1st wait control-section 115A as a reference sign. On the other hand, reference-sign change-over-switch 114B corresponding to 2nd base station 120B chooses the recovery signal to which it restored by 2nd demodulator 112B, or the recovery signal to which it restored by 1st demodulator 112A corresponding to the 1st base station of a moved material, and outputs it to 2nd wait control-section 115B as a reference sign.

[0029] That is, in the control station 110, the output of 1st demodulator 112A corresponding to 1st base station 120A of a moved material is connected to the input of wait control-section 115B of 2nd base station 120B of a migration place as a description of the mobile communication system of this invention. Therefore, since unlike the conventional system the whole sending signal which did not need to be made to generate a preamble as a reference sign and was being used in the area of a moved material can be used as a reference sign whenever area changes during migration, directive formation of the array antenna in the area of a migration place can be performed promptly.

[0030] 1st wait control-section 115A corresponding to 1st base station 120A computes the mean square error of the reference sign in which the selection output was carried out by 1st reference-sign change-over-switch 114A, and the output signal (signal by which weighting was carried out) of 1st beam formation circuit 111A. And based on the computed mean square error and the actual signal received by array antenna 130A of the 1st base station, the wait which makes said mean square error min is computed. The wait computed here is set as 1st beam formation circuit 111A.

[0031] At the time of initial communication link setting out, 1st reference-sign change-over-switch 114A chooses the output from the preamble generating circuit 113, and supplies it to wait control-section 115A by making this into a reference sign. If initial communication link setting out is completed, 1st reference-sign change-over-switch 114A will be supplied to wait control-section 115A by making the output from 1st demodulator 112A into a reference sign.

[0032] The initial wait before a wait is fed back from wait control-section 115A is set as 1st beam

formation circuit 111A corresponding to each signal line. Therefore, it becomes the sum which integrated the initial wait corresponding to the signal value to which the initial output of the 1st beam formation circuit has been sent through signal lines LA1, LA2, and LA3 at the time of initial communication link setting out. The 1st wait control section searches for the mean square error of the output signal of the preamble generating circuit 113, and the output of 1st beam formation circuit 111A, determines the wait which makes a mean square error min as this mean square error based on the input signal from array antenna 130A, and is made to feed it back to 1st beam formation circuit 111A, as mentioned above. After the directivity of array antenna 130A is formed of this feedback, the wait which makes a mean squared error min by the same approach is made to feed back to 1st beam formation circuit 111A, using the output of 1st demodulator 112A as a reference sign.

[0033] Now, a mobile station 150 is moving to the jurisdiction area of 2nd base station 120B from the jurisdiction area of 1st base station 120A, and presupposes that it went into the duplication area of such area. In this case, the sending signal of a mobile station 150 will be received also for array antenna 130of 2nd base station 120B B. Weighting of the 2nd beam formation circuit 111B corresponding to 2nd base station 120B is carried out to the signal value sent through each signal lines LB1, LB2, and LB3 using an initial wait. 2nd wait control-section 115B computes the mean square error of the reference sign which was chosen by 2nd reference-sign change-over-switch 114B, and was outputted, and the output signal of 2nd beam formation circuit 111B, computes the wait which makes a mean square error min based on the signal received by array antenna 130B of the 2nd base station, and sets this wait as 2nd beam formation circuit 111B.

[0034] 2nd reference-sign change-over-switch 114B carries out a selection output, using the output from 1st demodulator 112A as a reference sign until a mobile station 150 goes into the duplication area of jurisdiction area 140B of jurisdiction area 140A of the 1st base station, and 2nd base station 120B and the directivity of antenna 130B of the 2nd base station is formed. If the directivity of antenna 130B of the 2nd base station is formed, the selection output of the output of 2nd demodulator 112B will be carried out.

[0035] A control station 110 is equipped with a selecting switch 116 again. A selecting switch 116 is switched to the recovery signal which recovered the signal from the mobile station 150 given to a communication network by 2nd recovery section 112B from the recovery signal to which it restored by 1st demodulator 112A, when the mean square error computed by 2nd wait control-section 115B becomes below a predetermined value. That is, a mobile station 150 goes into jurisdiction area 140B of the 2nd base station, and the output of 2nd demodulator 112B corresponding to 2nd base station 120B is given to a communication network 100 noting that the directivity of antenna 130B of the 2nd base station will be formed proper, if the mean square error of the signal and reference sign which were received in the area becomes small enough.

[0036] Actuation of the mobile communication system constituted as mentioned above is explained with reference to drawing 3 -5.

[0037] With this operation gestalt, as mentioned above, a mobile station 150 starts a communication link by area 140A which 1st base station 120A covers, and actuation of the base station change-over at the time of moving to area 140B which 2nd base station 120B covers is explained.

[0038] Drawing 3 is a flow chart which shows actuation until 1st beam formation circuit 111A completes initial prehension and goes into the phase of directive flattery.

[0039] First, wait initial value for the beam formation circuits 111A and 111B to carry out weighting to an input signal is set as each beam formation circuit by the wait control sections 115A and 115B (step S301). The initial value of a wait can complete initial prehension in a short time by setting up so that directivity may turn to the field which 1st base station 120A of for example, a switching agency and 2nd base station 120B of a change-over place overlap and cover.

[0040] Subsequently, a communication link demand is performed by field 140A which 1st base station 120A covers that a mobile station 150 should start a communication link (step S303). 1st base station 120A assigns a communication channel to a mobile station 150 according to the communication link demand from a mobile station 150 (step S305). A mobile station 150 transmits a signal by the given

communication channel (step S307). In order to complete initial prehension for a short time at the time of this communication link initiation, the rate that a preamble occupies among transmitting frames is enlarged compared with an information bit.

[0041] It is received by array antenna 130A of the 1st base station, and weighting composition of the signal from a mobile station 150 is carried out by 1st beam formation circuit 111A using the set-up wait initial value (step S309).

[0042] The output signal of 1st beam formation circuit 111A is sent to 1st demodulator 112A, and it restores to it (step S311). Simultaneously, the output signal of 1st beam formation circuit 111A is sent also to 1st wait control-section 115A (step S313). On the other hand, the input signal received by array antenna 130A is directly inputted into 1st wait control-section 115A (step S315).

[0043] A mobile station 150 generates the same signal as the preamble which made it generate in a sending signal, and supplies the preamble generating circuit 113 to reference-sign change-over-switch 114A as a reference sign. Reference-sign change-over-switch 114A chooses this preamble signal, and outputs it to 1st wait control-section 115A (step S317).

[0044] 1st wait control-section 115A computes the mean square error of the reference sign from the preamble generating circuit 113, and the weighting signal from 1st beam formation circuit 111A, determines the wait which makes a mean square error min as this mean square error based on the input signal from array antenna 130A, and sets this as 1st beam formation circuit 111A (step S319).

[0045] At this time, it is judged whether the mean square error computed by 1st wait control-section 115A is below a predetermined value (step S321). When a mean square error is larger than a predetermined value, NO) and the directivity of still a request will be formed at the (step S321, and a process repeats step S319 from return and step S307 to step S307.

[0046] If a mean squared error is below a predetermined value (it is YES at step S321), desired directivity will be formed of 1st beam formation circuit 111A, and it will be considered that initial prehension was completed. In this condition, the error rate of the recovery signal to which it restored by 1st demodulator 112A is low. Then, it progresses to step S323 of drawing 4 , and a selecting switch 116 sends out the recovery signal to which it restored by 1st demodulator 112A to a communication network 100.

[0047] Drawing 4 is a flow chart which shows actuation when the directivity of an antenna is formed and 1st beam formation circuit 111A goes into the phase of directive flattery. In this phase, without using a preamble signal as a reference sign any longer, the signal to which it restored by 1st demodulator 112A is used as a reference sign so that it may mention later. By newly making a recovery signal into a reference sign, in addition to a preamble, wait control can be performed also in the section of an information bit, and directive flattery is made more as for 1st beam formation circuit 111A to accuracy according to the location of a mobile station 150. In addition, step S232 which begins to send out the output of 1st demodulator 112A to which the selecting switch 116 became low [ enough / an error ] to a communication network 100 is succeedingly from the decision step S321 of drawing 3 .

[0048] In drawing 4 , a mobile station 150 reduces the rate which a preamble shows in the signal transmission by the given communication channel after directive formation (step S325). In the phase of directive flattery, since wait control can be performed also in the section of an information bit, it is an increase of the rate of an information bit, and for carrying out and raising communication link effectiveness.

[0049] It is received by array antenna 130A of the 1st base station, and weighting composition of the signal from a mobile station 150 is carried out by 1st beam formation circuit 111A (step S327). The output signal of 1st beam formation circuit 111A is sent to 1st demodulator 112A, and it restores to it (step S329). Simultaneously, the output signal of 1st beam formation circuit 111A is inputted also into 1st wait control-section 115A (step S331). On the other hand, the input signal received by array antenna 130A of the 1st base station is directly inputted into 1st wait control-section 115A (step S333).

[0050] The recovery signal to which it restored by 1st demodulator 112A is sent to reference-sign change-over-switch 114A. Since directivity is already formed and close is in the phase of directive flattery at this time, reference-sign change-over-switch 114A chooses the output of 1st demodulator

112A as a reference sign, and outputs it to 1st wait control-section 115A (step S335).
[0051] 1st wait control-section 115A computes the mean square error of the reference sign and the output signal of 1st beam formation circuit 111A which were inputted, determines the wait which makes a mean square error min based on the input signal in this mean square error and array antenna 130A, and sets this as 1st beam formation circuit 111A (step S337).
[0052] When a mobile station 150 goes into duplication EIA of area 140B which area 140A which 1st base station 120A covers, and 2nd base station 120B cover in such the condition, in a control station 110, base station change-over actuation described below is performed. That is, initial prehension by 2nd beam formation circuit 111B corresponding to the 2nd base station and directive flattery which follows it are performed.
[0053] 1st base station 120A whose signal from a mobile station 150 is a switching agency as a description of this invention in the base station change-over condition received with both array antennas 130A and 130B of the 1st and 2nd base stations is still in the phase of directive flattery, and the error rate of the recovery signal to which it restored by 1st demodulator 112A uses this recovery signal as a reference sign for the 2nd base station using a low thing. That is, in addition to a preamble, wait control based on MMSE is performed also in the section of an information bit in inputting the recovery signal of 1st demodulator 112A corresponding to the 1st base station into 2nd wait control-section 115B corresponding to the 2nd base station. In this case, a preamble signal is newly generated, and initial prehension is not performed, but initial prehension is performed using the whole recovery signal. Therefore, 2nd beam formation circuit 111B can complete initial prehension in a short time, maintaining small the rate that a preamble occupies among the sending signals of a mobile station 150.
[0054] Array antenna 130B of the 2nd base station is also received by drawing 4 , and weighting composition of return and the signal from a mobile station 150 is carried out by 2nd beam formation circuit 111B at it (step S339).
[0055] The output signal of 2nd beam formation circuit 111B is sent to 2nd demodulator 112B, and it restores to it (step S341). Simultaneously, the output signal of 2nd beam formation circuit 111B is inputted also into 2nd wait control-section 115B (step S343). On the other hand, the input signal received by array antenna 130B of the 2nd base station is directly inputted into 2nd wait control-section 115B (step S345).
[0056] At this time, the recovery signal to which it restored by 1st demodulator 112A corresponding to the 1st base station is inputted into 2nd reference-sign change-over-switch 114B corresponding to the 2nd base station as a reference sign. 2nd reference-sign change-over-switch 114B chooses the recovery signal from this 1st demodulator 112A as a reference sign as it is, and supplies it to 2nd wait control-section 115B (step S347).
[0057] 2nd wait control-section 115B computes the mean square error of the inputted reference sign and the output signal of 2nd beam formation circuit 111B, determines the wait which makes a mean square error min based on this mean square error and the input signal of array antenna 130B of the 2nd base station, and sets this as 2nd beam formation circuit 111B (step S349).
[0058] The mean square error by which a selecting switch 116 is computed by 2nd wait control-section 115B judges whether it is below a predetermined value (step S351). When a mean square error is larger than a predetermined value, it means that NO) and the directivity of yet a request are not formed at the (step S351, and a process repeats return and processing of S323-S349 to step S323.
[0059] When a mean square error becomes below a predetermined value, it means that desired directivity was formed at the (step S351 of YES) and 2nd beam formation circuit 111B corresponding to the 2nd base station, and initial prehension is completed. Therefore, the error rate of the recovery signal to which it restored by 2nd demodulator 112B is low enough. In this case, a process progresses to step S353 of drawing 5 , and a selecting switch 116 chooses the recovery signal to which it restored by 2nd demodulator 112B, and sends this out to a communication network 100.
[0060] Thus, after the signal which the mobile station 150 transmitted is in the condition of mistaking through 2nd base station 120B of a migration place, and getting over there being nothing, a base station change-over is performed.

[0061] The mean square error by which the selecting switch 116 was computed by 2nd wait control-section 115B, When the mean square error computed by 1st wait control-section 115A is compared and the mean square error in 2nd wait control-section 115B becomes smaller than the mean square error in 1st wait control-section 115A It is good also as a configuration which switches the signal given to a communication network 100 to the recovery signal to which it restored by 2nd demodulator 112B from the recovery signal to which it restored by 1st demodulator 112A. In this case, when the receive state in 2nd base station 120B of a migration place becomes better than the receive state of 1st base station 120A of a moved material, a base station change-over can be performed and communicative dependability can be secured.
[0062] Moreover, a selecting switch 116 is good also as a configuration which compares continuously the mean square error computed from 2nd wait control-section 115B with the mean square error computed by 1st wait control-section 115A, and gives the recovery signal corresponding to the always smaller one to a communication network 100, while having received the signal from a mobile station 150 on the both sides of 1st base station 120A and 2nd base station 120B. By making it such a configuration, the effectiveness of site diversity (the output of the one where either is better is chosen) is acquired. Moreover, after the directivity of the antenna of the 2nd base station is formed, for example, the cure against shadowing of being maintained without a communication link breaking off can also be aimed at by substituting for the signal from 1st base station 120A, also when, as for close, communication failure occurs [ a mobile station 150 ] in the shade of obstructions, such as a truck.
[0063] As mentioned above, in the base station change-over to 2nd base station 120B from 1st base station 120A, actuation of the wait control for prehension in the 2nd base station uses the recovery signal corresponding to the 1st base station as a reference sign. Therefore, in addition to a preamble, the section of an information bit can also be used among the transmitting frames of a mobile station 150. The rate that an information bit occupies can shorten substantially time amount since it is very large compared with a preamble, until desired directivity is formed. Consequently, the area overlapped and covered between two base stations 120A and 120B is reducible.
[0064] Drawing 5 is a flow chart which shows actuation when 2nd beam formation circuit 111B corresponding to the 2nd base station goes into the phase of directive flattery. In the phase of directive flattery, the recovery signal to which it restored by 2nd demodulator 112B is newly used as a reference sign. In addition to a preamble, wait control can be performed also in the section of an information bit, and directive flattery is made more as for 2nd beam formation circuit 111B to accuracy according to the location of a mobile station 150.
[0065] First, a mobile station 150 transmits a signal by the communication channel given by 2nd base station 120B. It is good, maintaining small the rate that a preamble occupies among sending signals also here, compared with an information bit (step S355).
[0066] It is received by array antenna 130B of the 2nd base station, and weighting composition of the signal from a mobile station 150 is carried out by 2nd beam formation circuit 111B of a control station 110 (step S357). It restores to the output signal of 2nd beam formation circuit 111B by 2nd demodulator 112B (step S359). Simultaneously, the output signal of 2nd beam formation circuit 111B is inputted also into 2nd wait control-section 115B (step S361). On the other hand, the input signal received by array antenna 130B of the 2nd base station is directly inputted into 2nd wait control-section 115B (step S363).

[0067] Since the directivity in the 2nd base station was already formed and the low signal of an error rate has got over by 2nd demodulator 112B, reference-sign change-over-switch 114B chooses the recovery signal from 2nd demodulator 112B as a reference sign, and inputs this into 2nd wait control-section 115B (step S365). By computing the mean square error of the inputted reference sign and the output signal of 2nd beam formation circuit 111B, 2nd wait control-section 115B determines the wait which makes said mean square error min based on this mean square error and the input signal received by array antenna 130B of the 2nd base station, and sets this wait as 2nd beam formation circuit 111B (step S367).
[0068] In the above, this operation gestalt explained actuation of the base station change-over at the time

of a mobile station 150 moving to area 140B which area 140A to 2nd base station 120B which 1st base station 120A covers covers. What is necessary is just to carry out similarly about the base station change-over at the time of a mobile station 150 moving to area 140C which area 140B to 3rd base station 120C which 2nd base station 120B covers covers. In this case, steps S353-S367 are repeated until it performs the same decision processing as step S351 and the directivity in 3rd base station 120C is formed after step S367 (i.e., until the base station change-over to 3rd base station 120C from 2nd base station 120B is completed).

[0069] As mentioned above, according to this invention, it restores to the signal from the mobile station given through the base station of a switching agency, and uses as a reference sign, the wait which makes a mean square error min is computed, and this wait is set as the beam means forming corresponding to the base station array antenna of a change-over place. Thereby, the directivity of a change-over place base station array antenna can be formed in a short time. As a result, base station switching time can be shortened and it becomes possible for the field overlapped and covered between base stations to narrow. Conversely, if it says, installation spacing of a base station can be made large. Moreover, since it is not necessary to transmit the long signal of a preamble at every base station change, communication link effectiveness is highly maintainable.

[0070] By the way, when the mobile station has not transmitted the signal, wait control based on MMSE cannot be performed. Then, in the given communication channel, also when there is no information to transmit, as for a mobile station 150, it is desirable to always have transmitted the signal. Wait control based on MMSE can always be performed, and directivity can be made to follow accuracy more by carrying out like this according to the location of a mobile station.

[0071] Furthermore, directivity can be made to follow accuracy more according to the location of a mobile station, when a mobile station makes the always transmitted signal local station information, such as passing speed of a mobile station, and an obstruction. In addition, the safety of a cruise-assist highway system can be improved.

[0072] Although this invention is effective in especially the system by which the travelling direction of a mobile station was decided like ITS, it is applicable to the mobile communication system of arbitration by presuming the travelling direction of a mobile station.

[0073]

[Effect of the Invention] As explained in full detail above, according to this invention, in addition to the preamble section, wait control can be performed among the sending signals from a mobile station also in the section of an information bit by inputting the output signal of the recovery means corresponding to the base station of a switching agency into the wait control means corresponding to the base station of a change-over place as a reference sign. Therefore, the directivity of the array antenna of a change-over place base station is formed for a short time, and can narrow area overlapped and covered between base stations. Consequently, the installation cost of a base station can be reduced. Moreover, a long preamble becomes unnecessary and communication link effectiveness improves.

[0074] The wait control means corresponding to the base station of a change-over place computes the mean squared error of a reference sign and the output signal of the beam means forming corresponding to the base station of a change-over place, and sets the wait which makes this min as said beam means forming. Therefore, in addition to a preamble, wait control based on MMSE can be performed also in the section of an information bit.

[0075] Initial prehension can be completed in a short time by setting up so that directivity may turn to the field to which the base station of a switching agency and the base station of a change-over place overlap and cover the initial value of the wait set as the beam means forming corresponding to the base station of a change-over place.

[0076] Moreover, since a control station performs a base station change-over after being in the condition of desired directivity being formed, and the signal which the mobile station transmitted being mistaken through a change-over place base station in the array antenna of a change-over place base station, and getting over there being nothing, communicative soundness is secured.

[0077] Moreover, since a control station can also perform a base station change-over when the receive

state in a change-over place base station becomes better than the receive state in a change-over dimension base station, its communicative dependability improves.

[0078] Moreover, since a control station can give the output signal of the one where an error is always smaller to a communication network, the effectiveness of site diversity is acquired and it also becomes a cure against shadowing.

[0079] A mobile station can perform wait control based on MMSE continuously by always transmitting a signal in the given communication channel. Consequently, directivity can be made to follow accuracy more according to the location of a mobile station.

[0080] Directivity can be made to follow accuracy more according to the location of a mobile station, when a mobile station makes the always transmitted signal local station information, such as passing speed of a mobile station, and an obstruction. In addition, the safety of a cruise-assist highway system can be improved.

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[Translation done.]

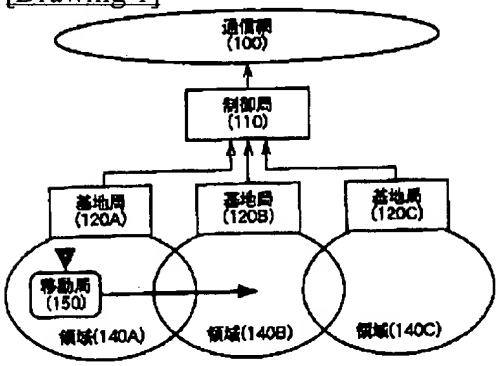
* NOTICES *



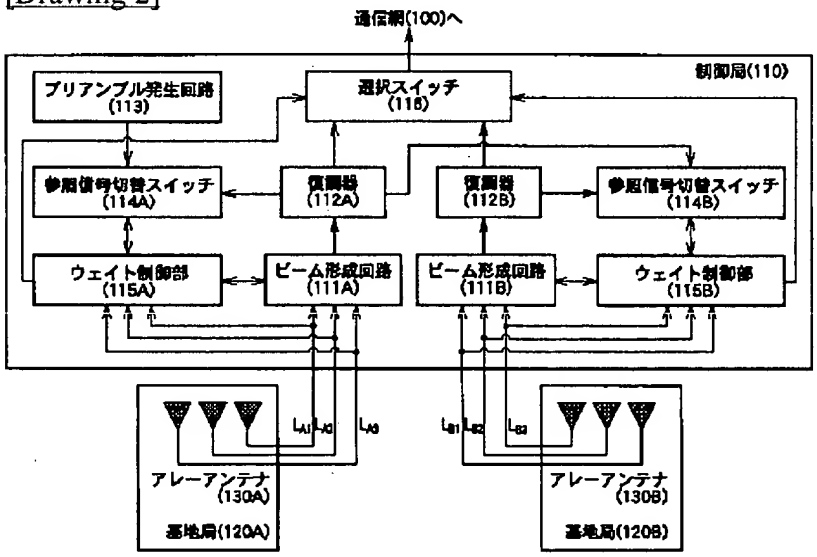
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

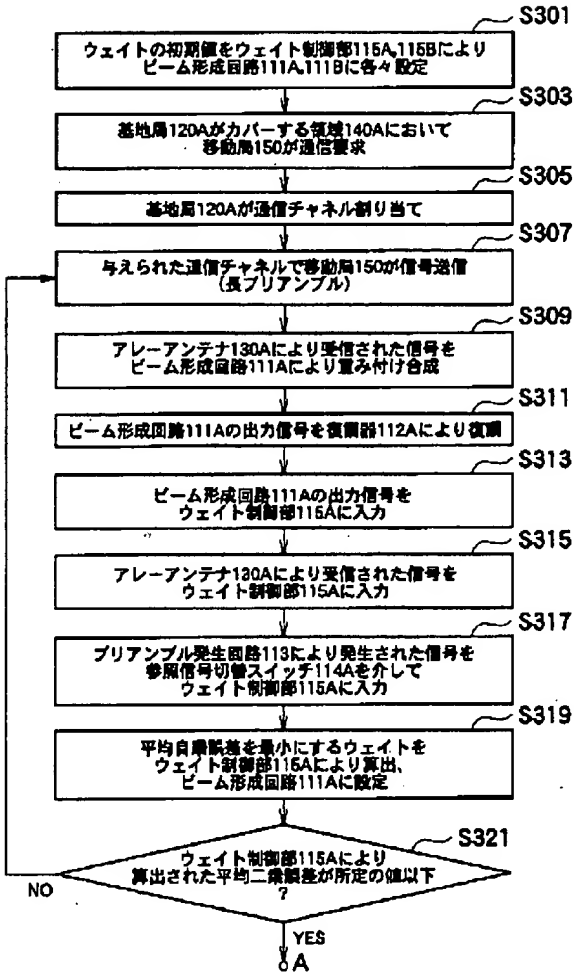
[Drawing 1]



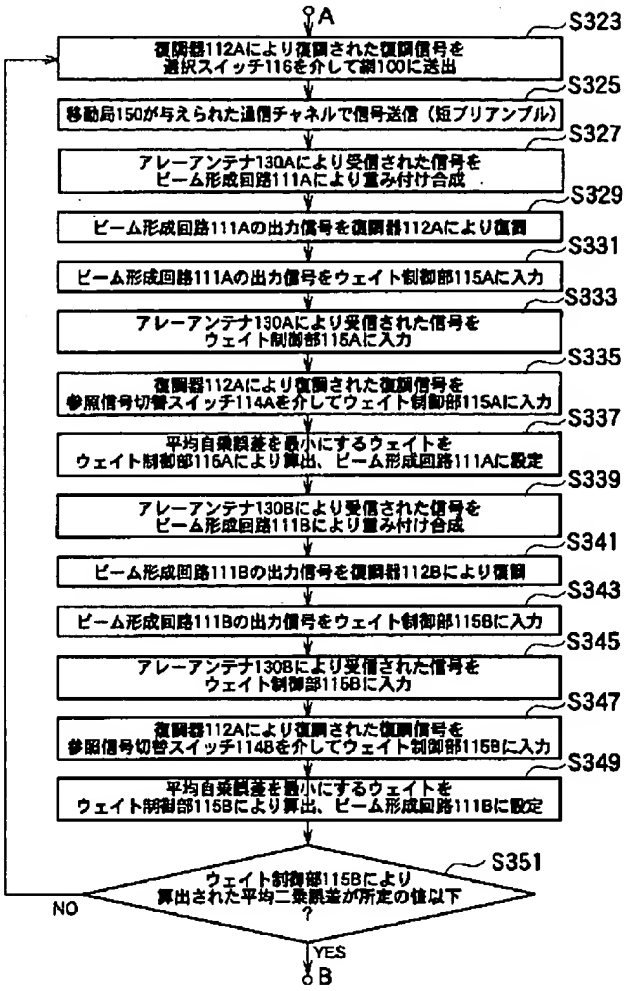

[Drawing 2]



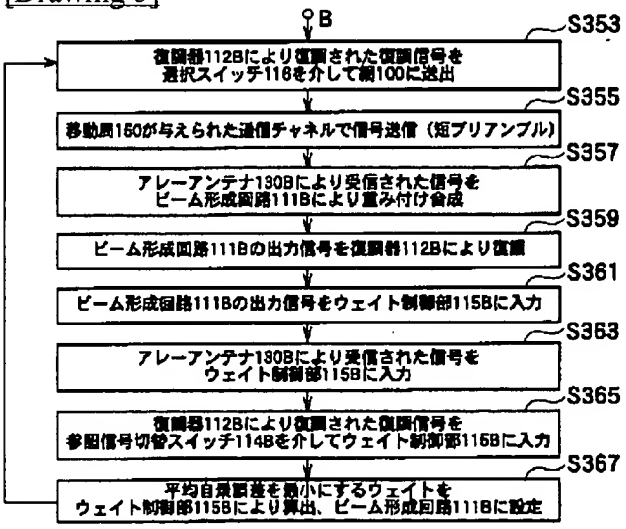

[Drawing 3]


S301
ウェイトの初期値をウェイト制御部115A,115Bにより
ビーム形成回路111A,111Bに各々設定
S303
基地局120Aがカバーする領域140Aにおいて
移動局150が通信要求
S305
基地局120Aが通信チャネル割り当て
S307
与えられた通信チャネルで移動局150が信号送信
(長プリアンブル)
S309
アレーアンテナ130Aにより受信された信号を
ビーム形成回路111Aにより重み付け合成
S311
ビーム形成回路111Aの出力信号を復調器112Aにより復調
S313
ビーム形成回路111Aの出力信号を
ウェイト制御部115Aに入力
S315
アレーアンテナ130Aにより受信された信号を
ウェイト制御部115Aに入力
S317
プリアンブル発生回路113により発生された信号を
参照信号切替スイッチ114Aを介して
ウェイト制御部115Aに入力
S319
平均自乗誤差を最小にするウェイトを
ウェイト制御部115Aにより算出、
ビーム形成回路111Aに設定
S321
ウェイト制御部115Aにより
算出された平均二乗誤差が所定の値以下
?
NO
YES
A

[Drawing 4]




[Drawing 5]




[Translation done.]